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Significance of field margins for foliage-dwelling spiders (Arachnida, Araneae) in an agricultural landscape of Germany

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Significance of field margins for foliage-dwelling spiders (Arachnida, Araneae) in an agricultural landscape of Germany. - In 1994 the spider composition of the herbaceous vegetation layer was investigated in uncultivated margins and - for reasons of comparison - some plots of fallow land in seven agricultural areas of Southern Germany were also examined. In total, 69 spider species with 10503 specimens were recorded by standardized visual search. The margin density per study area varied between 75 and 300m/ha. Species number is significantly positively correlated with margin density of the area as a whole and margin width, respectively, while mechanical treatment has negative influence on species number. The abundance of single species is correlated with specific landscape and habitat characteristics, such as margin density, margin width and mechanical treatment. Some species indicate a high connectivity of uncultivated areas in agricultural landscapes. Recommendations for landscape planning such as an optimal margin width of at least 3 to 5m are given in reference to foliage-dwelling spiders.

Key-words: Agriculture - foliage-dwelling spiders - field margins - fallow land - assessment for nature conservation

INTRODUCTION

During the last decades, a growing cultivation intensity corresponded to a continuous increase in field size in Germany. This resulted in a considerable loss of uncultivated areas, e.g. field margins and hedgerows, and in a decrease in spatial and structural heterogeneity in agricultural landscapes (KAULE 1991). This reflects a general trend in agricultural use in many parts of the world (PLACHTER 1991). Recently, the significance of these uncultivated areas as wildlife habitat, refugial areas and especially for pest control was studied by several authors (WAY & GREIG-SMITH 1987, BOATMAN 1994). Most investigations have focussed on the function, design and management of hedgerows in agricultural landscapes (ZWÖLFER *et al.* 1984, ROTTER

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& KNEITZ 1977). There is less information on field margins, especially concerning invertebrates. Field margins are defined as grassy strips or banks between fields or meadows, which normally will not be cultivated or ploughed and may contain only single shrubs or trees. Data already exist for field margins concerning vegetation, carabid beetles, butterflies and other flower-visiting insects and ground-dwelling spiders (BOATMAN 1994). Less is known about spiders of the herbaceous layer, although they depend directly on the structural diversity of the vegetation for building webs and hiding places (KAJAK 1971). In this publication, the influence of some landscape and habitat characteristics on these spider composition and distribution is presented and discussed. The spatial structure of fallow land is often quite similar to those of field margins. Thus, fallow land might be considered to be 'extremely broad' margins. Adopting this point of view, several areas of fallow land were investigated for comparison. From investigation on the ecology of the Grey Partridge (*Perdix perdix*) (POTTS 1986), we know of fundamental changes of the invertebrate faunas of field margins relating to landuse change. As field margins and fallow land are common elements of agricultural landscapes, their role as habitats and for dispersal of species is of considerable significance for nature conservation and planning. Until now, assessment of these habitats bases primarily on vegetation features (BLAB 1993, KAULE 1991, PLACHTER 1989). Thus, additional information related to animals is needed.

Data of this investigation were analyzed with regard to the following three questions:

1. Are there differences in the spider faunas between single study plots and the study areas in relation to landscape and habitat structure?
2. Which habitat characteristics determine the composition of the spider faunas?
3. To which extent do single spider species discriminate between different qualities of habitat characteristics?

METHODS AND STUDY AREAS

Data were collected by standardized visual search in the herbaceous vegetation layer. Standardization was achieved by monitoring only species being conspicuous by their body size, characteristic webs, hiding places or cocoons and by using a constant study plot-size of 1m x 50m in uncultivated margins and some fallow land, respectively, by comparison. This method was choosen to record those foliage-dwelling spider species, which are normally not registered by sweeping or by the use of vacuum suction samplers. Furthermore, this method minimizes habitat disturbance during a series of investigations at identical sites. Juveniles and adults of the studied species, could be normally determined to species or at least genus level in the field without killing or even disturbing the spiders. Only adults of certain genera, e.g. *Clubiona*, *Enoplognatha* and *Xysticus*, had to be collected for exact species determination in the laboratory. The mainly ground-dwelling lycosid spiders and the small erigonid spiders were excluded from the investigations, because they could not be registered representatively by this method.

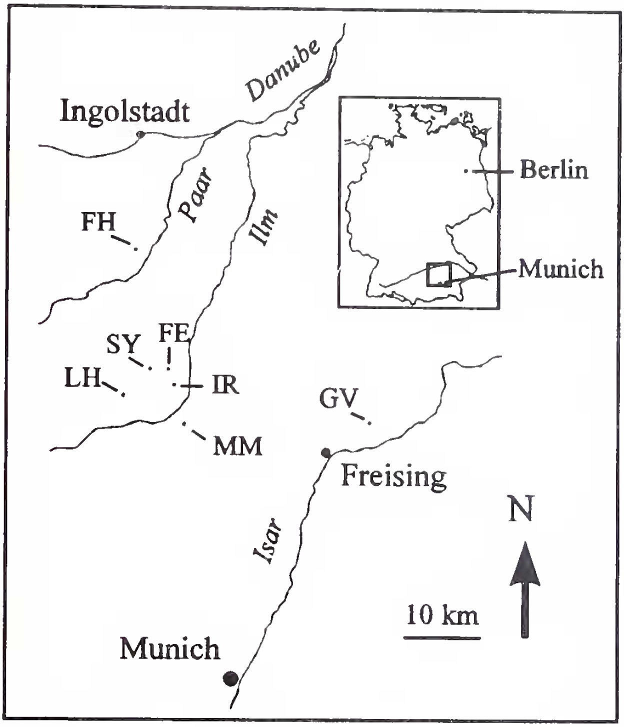

FIG. 1

Location of the study areas (FE = 'Fernhag', FH = 'Freinhausen', GV = 'Großenviecht', IR = 'Ilmried', LH = 'Lichthausen', MM = 'Mittermarbach', SY = 'Scheyern') in Southern Germany. Inset: map of Germany.

The investigations were conducted in seven agricultural landscapes situated in the same geographic region, a hilly landscape between the rivers Isar and Danube in Southern Germany (Fig. 1) (BARTHEL & PLACHTER 1995). The study areas are named according to neighbouring villages (Fig. 1). The number of study plots, that were parts of margins or fallow land, varied between 12 and 17 per study area. Each study plot was sampled once per month from May to September in 1994.

The investigated habitat characteristics were margin density (concerning the study areas), margin width and the number of man-made mechanical treatments (both latter parameters concerning single study plots). The margin density (m/ha) was defined as the sum of all margins with at least 50cm in width divided by the size of the study area. In the study areas, the width of all margins was measured every 25m. Margins with a smaller width were ignored, because they were considered only as a temporary borderline between two different cultivated fields and did not function as a stable habitat.

TABLE 1

Margin density, number of study plots investigated in each area and number of margins with mechanical treatment per each study area.

Study areas	GV	MM	SY	LH	FE	IR	FH
Margin density [m/ha]	75	115	150	160	230	250	300
Number of study plots per area	13	14	15	12	17	14	14
No treatment	4	11	10	6	7	11	12
1 treatment	5	3	3	5	8	2	2
2-3 treatments	4	---	2	1	2	1	---

At each study plot and each of the five sampling periods, mechanical treatment, which resulted in a more or less total destruction of vegetation structure, was registered. The habitat parameter 'treatment' includes the number of observed treatments without discriminating between the different types of treatment, e.g. mowing, cutting, ploughing or trampling. Therefore, possible values of treatment could range between 0 to 5, while actually 0 to 3 treatment events per study plot occurred. Margin density and variation in treatment frequency of each area are summarized in table 1. Spearman rank correlation (two-tailed) and regression analysis of the statistic-program WinSTAT were used to analyze relations between spider species number and studied habitat characteristics.

RESULTS

Data analysis was carried out on three levels: First, the **study areas** were compared by spider composition and species number. Secondly, a more detailed analysis focussed on single **study plots**. Thirdly, single **spider species** and their habitat requirements were considered.

TABLE 2

Presence in study areas (7), frequency in study plots (99) and abundance of all foliage-dwelling spider species. Species are listed according to decreasing presence in the plots. Recorded species of the genera *Araniella*, *Philodromus* and *Heliophanus*, respectively, were listed together because of the large number of juveniles, which are not determinable to species level.

Spider species	Presence (7 areas)	Frequency (99 plots)	Number of specimens	Abundance %
Theridion impressum L.Koch, 1881	7	94	1400	13.33
Argiope bruennichi (Scopoli, 1772)	7	80	1175	11.19
Aculepeira ceropegia (Walckenaer, 1802)	7	77	424	4.04
Mangora acalypha (Walckenaer, 1802)	7	74	320	3.05
Pisaura mirabilis (Clerck, 1757)	7	72	862	8.21
Tetragnatha pinicola L.Koch, 1870	7	65	354	3.37
Linyphia triangularis (Clerck, 1757)	7	55	305	2.90
Clubiona reclusa O.P.-Cambridge, 1863	7	54	470	4.47
Theridion impressum L.Koch, 1881	7	94	1400	13.33
Larinioides folium (Schrank, 1803)	6	49	1063	10.12
Enoplognatha ovata (Clerck, 1757)	7	47	528	5.03
Enoplognatha latimana Hippa & Oksala, 1982	7	46	380	3.62
Evarcha arcuata (Clerck, 1757)	7	39	555	5.28

Microlinyphia pusilla (Sundevall, 1830)	7	39	81	0.77
Xysticus ulmi (Hahn, 1831)	7	37	188	1.79
Xysticus cristatus (Clerck, 1857)	7	36	197	1.88
Araneus quadratus Clerck,1757	6	35	858	8.17
Metellina segmentata (Clerck, 1757)	7	34	212	2.02
Theridion bimaculatum (Linnaeus, 1767)	7	28	41	0.39
Araniella cucurbitina (Clerck,1757) / *opisthographa* (Kulczynski, 1905)	7	23	33	0.31
Xysticus bifasciatus C.L.Koch, 1837	5	20	103	0.98
Agelena labyrinthica (Clerck, 1757)	6	19	276	2.63
Xysticus kochi Thorell, 1872	6	19	68	0.65
Philodromus aureolus (Clerck, 1757) / *cespitum* (Walckenaer, 1802) / *collinus* C.L.Koch, 1835	6	18	41	0.39
Tetragnatha extensa (Linnaeus, 1758)	5	18	61	0.58
Heliophanus auratus C.L.Koch, 1835 / *cupreus* (Walckenaer, 1802) / *flavipes* Hahn, 1832	5	18	28	0.27
Floronia bucculenta (Clerck, 1757)	6	17	83	0.79
Araneus diadematus Clerck, 1757	5	16	29	0.28
Cheiracanthium erraticum (Walckenaer, 1802)	2	11	42	0.40
Agalenatea redii (Scopoli, 1763)	1	11	194	1.85
Cyclosa oculata (Walckenaer, 1802)	6	10	12	0.11
Clubiona neglecta O.P.-Cambridge, 1862	5	7	19	0.18
Neriene clathrata (Sundevall,1830)	5	6	8	0.08
Dictyna arundinacea (Linnaeus, 1758)	4	5	15	0.14
Cyclosa conica (Pallas, 1772)	3	5	7	0.07
Achaearanea spec.	2	3	4	0.04
Cercidia prominens (Westring,1851)	1	3	8	0.08
Theridion sisyphium (Clerck, 1757)	2	2	9	0.09
Hypsosinga sanguinea (C.L.Koch, 1844)	2	2	3	0.03
Micaria formicaria (Sundevall, 1832)	2	2	2	0.02
Nuctenea umbratica (Clerck, 1757)	2	2	2	0.02
Evarcha flammata (Clerck, 1757)	1	2	5	0.05
Xysticus audax (Schrank, 1803)	1	2	5	0.05
Metellina mengei (Blackwall, 1869)	1	2	2	0.02
Misumena vatia (Clerck, 1757)	1	2	2	0.02
Clubiona lutescens Westring, 1851	1	1	3	0.03
Xysticus lanio C.L.Koch, 1835	1	1	3	0.03
Xysticus luctuosus (Blackwall, 1836)	1	1	3	0.03
Araneus alsine (Walckenaer, 1802)	1	1	2	0.02
Araneus triguttatus (Fabricius, 1775)	1	1	2	0.02
Clubiona pallidula (Clerck, 1757)	1	1	2	0.02
Agelena gracilens C.L.Koch, 1841	1	1	1	0.01
Araneus sturmi (Hahn, 1831)	1	1	1	0.01
Bianor aurocinctus (Ohlert, 1865)	1	1	1	0.01
Dolomedes spec.	1	1	1	0.01
Ero spec.	1	1	1	0.01
Lathys humilis (Blackwall, 1855)	1	1	1	0.01
Lepthyphantes tenuis (Blackwall, 1852)	1	1	1	0.01
Linyphia hortensis Sundevall, 1830	1	1	1	0.01
Neriene radiata (Walckenaer, 1841)	1	1	1	0.01
Pachygnatha clercki Sundevall, 1823	1	1	1	0.01
Steatoda phalerata (Panzer,1801)	1	1	1	0.01
Tetragnatha nigrita Lendl, 1886	1	1	1	0.01
Theridion mystaceum L.Koch, 1870	1	1	1	0.01
Theridion tinctum (Walckenaer, 1802)	1	1	1	0.01
sum of total specimens			10503	100.00

In total, 69 spider species with 10503 specimens were recorded (Table 2). About one quarter of the species (17) was found in all study areas and another quarter (13) in most of them (5 or 6). Two species (*Cyclosa conica* and *Dictyna arundinacea*) were present in 3 or 4 study areas, respectively. The rest of the species (about 50% of all) were recorded only in one or two study areas and, with the exception of two species, with less than 10 specimens. *Cheiracanthium erraticum* and *Agalenatea redii* were regularly found with a moderate number of individuals in one study area (FH).

The total number of species as well as the range of species number per study plot within one area differs considerably (Fig. 2). Total species number increases significantly ($p<0.01$) from the area with the lowest to the area with the highest margin density as well as the minimum ($p<0.01$) and maximum ($p<0.05$) number of species found in study plots in one area (Spearman rank correlations). Furthermore, the overall abundance of single species (Table 2) is highly positively correlated with as well the presence of species in study areas ($p<0.001$) as the frequency of species in study plots ($p<0.001$) (Table 2).

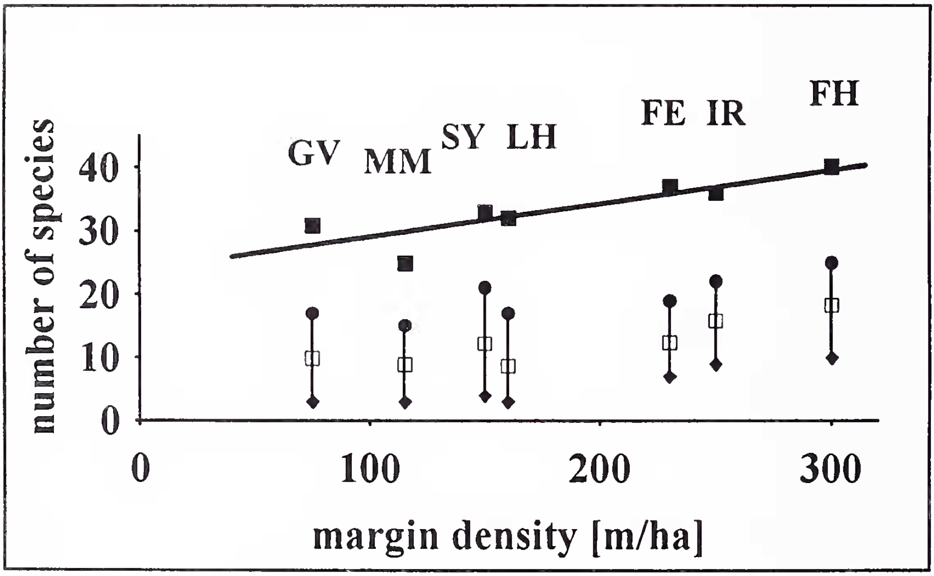

FIG. 2

Total number of spider species per study area (■), maximum number of species found in a study plot in this study area (●), average number of species per study plot (□) and minimum number of species found in a study plot in this study area (♦). The total number of species increases linearly with growing margin density of the single study areas (R^2 = 0.85). For abbreviations of study areas see Fig.1.

Although, the study areas resemble high in species composition with respect to the more abundant species (more than 0.1% overall abundance), significant differences between single study plots were observed. For example, the frequency of six spider species in the study plots of the seven study areas is given in Fig. 3. *Theridion impressum* and *Argiope bruennichi* were consistently well distributed in the study areas. In contrast, the other four species have an irregular distribution: in some areas, they were registered only with low frequency or were absent (*Araneus quadratus* and *Xysticus bifasciatus*). These differences in frequency between the study areas are typical for most of the more abundant spider species.

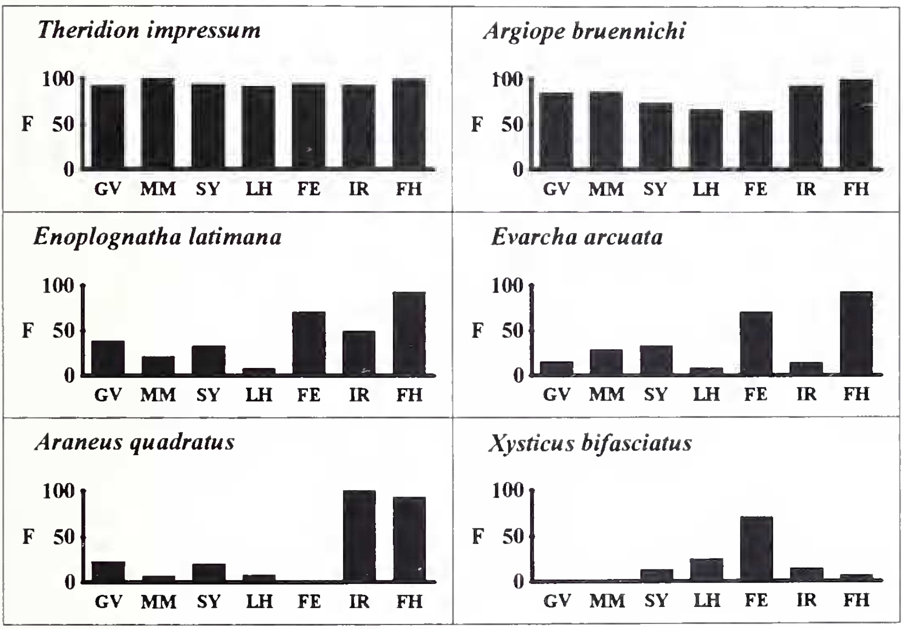

FIG. 3

Frequency of 6 spider species on the study plots of a study area, compared for all 7 study areas. For each area, the percentage of study plots inhabited by this species was calculated (F). *Theridion impressum* and *Argiope bruennichi* show a high frequency in all areas, whereas others, eg. *Araneus quadratus*, concentrate on single areas.

The frequency of the species in the study plots steeply declines: only eight species (*Theridion impressum* to *Clubiona reclusa*) were recorded in more than half of the study plots (Table 2). Thus, the small-scale variation of the spider communities between different study plots is rather high.

The number of species and specimens per study plot are positively correlated with the margin density of study areas and the margin width of study plots (Table 3). The number of species increases with growing margin density in 6 study areas only,

TABLE 3

Correlation coefficients, calculated for the number of species and specimens per study plot, respectively, and the environmental characteristics margin density, margin width and number of mechanical treatments (***: $p<0.001$, Spearman rank correlation).

	No. of species per plot	No. of specimens per plot
Margin density	0.54 ***	0.39 ***
Margin width	0.46 ***	0.37 ***
Number of mechanical treatments	-0.40 ***	-0.40 ***

while in the area FH, which has the highest margin density, the species number declines significantly (Table 4).

The best fitted regression (maximum R^2) between the environmental parameter 'margin width' and the variable 'species number per study plot' was calculated. The equation and the response curve is shown in Fig. 4. Some specifications of this response curve are: At the beginning of the response curve, while the margin width

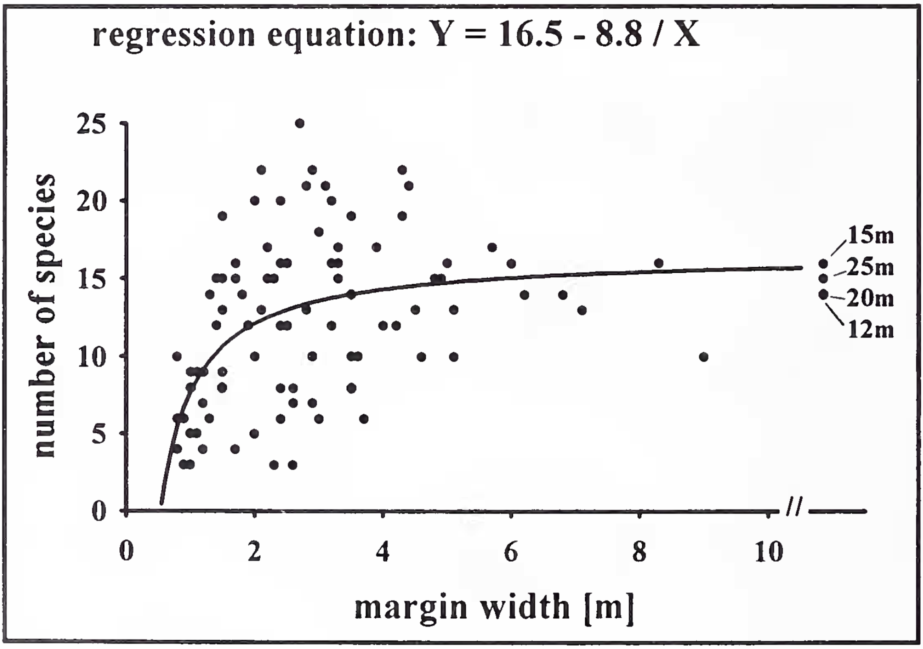

FIG. 4

Number of spider species per study plot versus margin width of this study plot (99 study plots investigated). 4 study plots had a margin width of more than 10m. They are plotted at the right edge of the diagram. The response curve between margin width and species number (solid line) bases on the regression equation given on the top of this figure (R^2 = 0.25). The number of species saturates with increasing margin width. The regression equation indicates a maximum number of species between 16 and 17 species per study plot in the areas investigated.

ranges between less than 1m and 2m, the increase in species number is very steep. The scattering of species numbers is much higher in smaller margins (1.5 to 4m in width) than in larger margins (>4m). The equation indicates a saturation of 16 to 17 species per study plot. This is proved also by four study plots in fallow land with more than 10m in width (Fig. 4). R^2 is 0.25. Thus, one quarter of the scattering of species number per study plot is explained by the environmental parameter margin width.

For single margins, the number of species and specimens per study plot is significantly negatively correlated with the number of mechanical treatments ($p<0.001$, Table 3). Thus, the number of species and specimens, respectively, declines with growing number of treatments.

TABLE 4

Spearman rank correlations between margin width and number of species per study plot analyzed separately for each study area (level of significance: **: $p<0.01$; *: $p<0.05$, n.s.: non-significant). Although, correlation coefficients in the study areas GV and LH are higher than 0.46 (see table 3: correlation coefficient for all study plots in all areas together), they fail to reach significance, due to the low numbers of study plots in these areas.

Study areas	GV	MM	SY	LH	IR	FE	FH
Correlation	0.47 n.s. (p=0.107)	0.69 **	0.34 n.s. (p=0.213)	0.53 n.s. (p=0.074)	0.58 *	0.66 **	- 0.71 **

The abundance of each frequently observed spider species (>0.5% of all individuals) was correlated with the habitat parameters investigated, i.e. margin density, margin width and habitat treatment (Table 5).

The abundances of *Evarcha arcuata*, *Enoplognatha latimana* and *E. ovata*, *Pisaura mirabilis* and *Xysticus cristatus*, which occur in all 7 study areas, are highly correlated with margin density as well as with margin width. *Enoplognatha ovata*, *Clubiona reclusa* and *Linyphia triangularis* react sensitively on the destruction of vegetation layer by mechanical treatments. For other species, e.g. *Argiope bruennichi*, *Microlinyphia pusilla* and *Theridion impressum*, there is no correlation between abundance and margin density and width and (except of *Argiope*) treatment. Thus, some of the abundant species obviously reflect very well the habitat and environmental qualities of an agricultural landscape and of single margins as well.

DISCUSSION

The number of publications on foliage-dwelling spiders is low compared with those on ground-dwelling spider communities. ALDERWEIRELDT (1993) compared the spider faunas of field margins and field centers in Belgium. Other authors investigated the spider fauna in abandoned grassland (KAJAK 1971: Poland; NYFFELER & BENZ 1987: Switzerland) or in cultivated grassland (VILBASTE 1964: Estonia; BUCHAR 1968:

TABLE 5

Habitat requirements of selected spider species (>0.5% of all individuals): the abundances of these species are correlated with the environmental characteristics (Spearman rank correlation; positive correlation: +++: p<0.001; ++: p<0.01; +: p<0.05; negative correlation: ---: p<0.001; --: p<0.01; -: p<0.05).

Species	Margin density / study area	Margin width	Mechanical treatment
Tetragnatha extensa			
Tetragnatha pinicola	+++		
Metellina segmentata	+++		-
Aculepeira ceropegia	+	+	
Agalenatea redii	+++	++	-
Araneus quadratus	+++		-
Argiope bruennichi			--
Larinioides folium	---		
Mangora acalypha	+		-
Floronia bucculenta	+++		
Linyphia triangularis	+++		---
Microlinyphia pusilla			
Enoplognatha latimana	+++	++	
Enoplognatha ovata	++	+++	---
Theridion impressum			
Pisaura mirabilis	++	+++	--
Agelena labyrinthica	+++	+++	
Clubiona reclusa		+++	---
Xysticus bifasciatus	+	++	
Xysticus cristatus	++	+++	-
Xysticus kochi			
Xysticus ulmi		+	
Evarcha arcuata	+++	+++	-

Czech Republic; HUHTA & RAATIKAINEN 1974: Finland; SCHEIDLER 1990: Germany). All frequent species in this study (recorded in 5 to 7 areas) are mentioned by at least one of these authors, too.

The most abundant species in this study is *Theridion impressum*. SCHEIDLER (1990) recorded *Theridion impressum* also as the most abundant species (more than 10 %) in dry and wet meadows. The presence of *Argiope bruennichi* in recent studies (NYFFELER & BENZ 1987) is a consequence of the actual expansion of the area of this species (GUTTMANN 1979).

Variations in abundance might be caused by another sampling-method or the differing habitat types (dry or wet meadows, abandoned or intensively cultivated meadows). For instance, *Microlinyphia pusilla* and especially *Pachygnatha clercki* and *P. degeeri* were found more frequently in other studies (VILBASTE 1964, BUCHAR

1968, HUHTA & RAATIKAINEN 1974), in which sweeping or quantitative quadrat sampling were used. Some geographic variations are recorded, e.g. *Larinioides folium* is replaced by *L. cornutus* in the northern regions of Europe (THALER 1974). Two species (i.e. *Agalenatea redii, Cheiracanthium erraticum*) were recorded in high abundance in only one or two study areas. Whereas *Cheiracanthium erraticum* was registered several times in abandoned grassland (e.g. KAJAK 1971, VILBASTE 1964), *Agalenatea redii* seems not to be a species widely distributed in agricultural landscapes. This species was collected only by DUFFEY (1968) in a dune meadow.

There might exist different reasons for the low abundance of some species in this investigation:

- rare species (e.g. *Lathys humilis*),
- species which normally do not occur in open agricultural landscapes (e.g. *Xysticus lanio, X. luctuosus* and *Araneus sturmi* and *A. triguttatus* inhabit woods and their edges) and
- species which were systematically overlooked by reasons of the sampling-method (e.g. *Pachygnatha clercki*).

For the geographic region investigated, a 'typical' spider community can be characterized for the herbaceous layer of margins and fallow land. It is defined to be represented by all species with a presence in at least 5 study areas (Table 2). This spider community is present more or less completely in uncultivated areas and depends on specific environmental characteristics, there. One essential parameter is the margin width. Saturation of species number is reached between a width of 5 to 10m. Between 1 and 5m width, the species numbers differ considerably from margin to margin. High species diversity is possible, but often the number of species is remarkable low. This is especially true for areas with low margin density.

The high scattering of species number in small margins might be caused by an increased habitat disturbance, e.g. man-made mechanical treatments. Actually, the width of margins and the number of mechanical treatments observed were significantly negatively correlated. KAULE (1983 *in* KAULE 1991) demonstrates that margins with at least 3 to 4m in width accommodate more specialized plant species, while in smaller margins only few ubiquists dominate. ZORNBACH & SCHICKEDANZ (1987) proved that species diversity increases with margin width: margins of more than 2 to 3m are rich in insect life. MIOTK (1993) describes a slightly positive correlation between margin width and species number of flower visiting insects. Moreover, the number of vascular plant species is significantly positively correlated with the margin width up to a width of 3m (MIOTK 1993, ANDERLIK-WESINGER *et al.* 1996). Even for bird populations, minimum standards for margin width are given: breeding sites for partridges should have a size of at least 2m in width and 20m in length (Gießener Arbeitskreis Wildforschung 1979, *in* BLAB 1993). PARISH *et al.* (1995) mentioned that margin width appeared important for small insectivorus birds (blue tit) and was particularly important for seed eating birds.

Study area FH is characterized by the highest margin density. More spider species were observed here on smaller margins than on broader margins or fallow land. Obviously, due to a good connectivity of uncultivated areas (SCHREIBER 1988), recolonization even of small uncultivated areas is facilitated in such areas.

In the region investigated, frequently, mechanical treatments of margins affect only the edge (about 1-2m in width) of each side of the margin, bordering directly to fields or grassland. Thus, an undisturbed central zone can establish, which might be one reason for the higher number of species in wider margins than in smaller ones. Other reasons for the positive correlation between abundance of some species and the margin width may be:

- an increase in plant diversity as well as in herb cover (Anderlik-Wesinger et al. 1996) and
- lower input of agrochemicals and manure of the adjacent fields.

Furthermore, the sensitivity of spider species to destruction of vegetation layer may result from:

- direct removal of specimens caused by the treatment: this affects most of the species, but some species avoid the removal by falling to the ground,
- mowing affects cocoons or offspring in the higher vegetation strata,
- the loss of vegetation structure for building a web and
- microclimatical changes after mowing.

Some species, e.g. *Tetragnatha extensa* and *Microlinyphia pusilla*, were frequently recorded in meadows (VILBASTE 1964, BUCHAR 1968, HUHTA & RAATIKAINEN 1974). They react sensitively neither to the density of margins and fallow land nor to mechanical treatments.

The sensitivity of *Enoplognatha ovata* to mechanical treatment was shown also by OXFORD (1993). For this species and for *Clubiona reclusa*, the sensitivity to mowing or cutting of vegetation might be a result of phenology. Both species, including the offspring, live in rolled-up leaves in the higher vegetation strata in July and August. At this time of the year, many margins are encroached upon mechanically as a consequence of harvesting (BARTHEL & PLACHTER 1995). *Linyphia triangularis* reacts negatively on the destruction of vegetation layer, because this species is living in higher vegetation strata than *Floronia bucculenta* and *Linyphia clathrata* (SCHAEFER 1978).

As well, other environmental parameters, e.g. cover of herbs, plant species diversity, inclination of margins and nitrogen load, influence the composition of the spider communities on field margins and fallow land (ANDERLIK-WESINGER *et al.* 1996). Finally, abiotic environmental factors (e.g. humidity, temperature and light) play an important role for spider distribution (DUFFEY 1975).

For management and planning in nature conservation, indicators are required, which sufficiently reflect the state and the development potential of ecosystems and landscapes, respectively, and which are easily to be analyzed in everyday practice (PLACHTER 1989, 1994, RIECKEN 1992). It is made probable that the significance of field margins for foliage-dwelling spiders is determined - among others - by the following parameters:

1. The habitat quality correlates with the width. Margins, narrower than 1m, accommodate fragments of the typical community at the best. Their habitat function is low. Margins between 1 and 5m in width may be habitat for a diverse spider community, but the local composition depends much on other environmental parameters. Thus, at least some field margins of an agricultural area should reach a width of more than 2 to 5m. Additional fallow land substantially improves the habitat supply. Similar correlations to width exist for example for hedges (Zwölfer *et al.* 1984, Rotter & Kneitz 1977).
2. Mechanical treatment highly influences the foliage-dwelling spiders of margins. This is demonstrated as well for meadows (Kajak 1971). Thus, the farmers should be requested not to drive frequently over margins. A mowing and management regime should be carried out in sections, not every year and varying during the seasons to avoid frequent elimination of certain species due to their phenology.
3. Obviously, suitability of a specific margin does not only depend on its environmental features, but also on the spatial configuration of uncultivated habitats of the area, in which it is situated. There is a good correlation between width of margins and species set in uniform landscapes but none in diverse ones. It sounds logical that the sigificance of the single margin is higher in uniform landscapes, whereas in diverse landscapes a local population can use several adjacent margins in the line of the metapopulation concept, thus, not so much depending on the quality of one margin to establish and survive. As a consequence, in uniform landscapes isolated margins shculd be much wider.

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